No. 89 November 1999

solplan review

the independent journal of energy conservation, building science & construction practice

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From the Editor . . .

Isn't human nature strange? On one hand, we are capable of great accomplishments, warmth and love. On the other hand, we can be aggressive and mean.

Meanspiritedness seems to be a powerful force, or is instinct? How else to explain the aggressive behaviour we exhibit in so many of our interpersonal activities? And here I don't want to dwell on the wars and other atrocities people are so capable of inflicting on each other. I am thinking more of how we go about conducting our business affairs. Have you noticed how much aggression and violence is part of the normal way of doing business? There is a "take no prisoners" type of mentality.

So many of our activities are adversarial, with little opportunity for cooperative work. Our industry is particularly impacted by this, even though we all have a common goal: to deliver an attractive, durable shelter for residence and work. However, the means we use to do this are rife with aggression, distrust, and suspicion.

The building official is distrusted. He is treated like the unwanted policeman who is out looking for law breakers. The architect (if he's involved in the project) thinks the builder is trying to put one over him. In smaller projects, the builder may often try and convince the owner to dispense with the architect altogether. The owner takes it for granted that the builder is trying to screw him. And so it goes. We've all encountered cases where some or all of these cases have happened.

The recent problems in BC underline this. I've noticed how this adversarial way is almost getting in the way of solving some rather serious problems that have affected the credibility of the entire industry. There seems to be a manic drive to try and find the guilty culprit for the problems that have afflicted the industry, and our customers, even though it's been clearly identified that a systemic breakdown occurred, with all parties sharing the blame. We've run a number of stories in the past year explaining the nature of the problem.

Yet there still is a sizeable group that is trying to lay blame for the problems on a single cause. Governments seem to have the deepest pockets, so there is a concerted effort to try and assign blame. Some are still trying to put blame on the building code, perhaps because it is the evil government that puts the final stamp on the document. These people in turn choose to ignore the fact that the code is developed on a wide industry consensus, and with considerable scrutiny. Too often, careful scrutiny means the review and approval process seems to last an eternity. Then again, it may be a case of trying to pin the blame on someone or some single entity so that one is off the hook for one's own errors and misdemeanours.

What is a shame is that, in the confrontational structure we've set up, it is extremely difficult to seriously address common issues, to recognize that some things must be done because there is sound technical reason behind doing them. In other cases, and because each building usually is a prototype (there is very little true repetition in this industry), we need to be honest and frank when assessing successes and failures, and be ready to learn from them. And not resort to name calling.

Richard Kadulski,
Editor

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ISSN: 0828-6574
Date of Issue: December 1999
SOLPLAN REVIEW is published 6 times per year by:
the drawing-room graphic services ltd.
Box 86627, North Vancouver, BC V7L 4L2
Tel: 604-689-1841 Fax: 604-689-1841
e-mail: solplan@direct.ca
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#204 - 1037 West Broadway
Vancouver, BC V6H 1E3

Canadian Publications Mail Product Sales Agreement No. 454532
Postage paid in Vancouver, BC.

SUBSCRIPTIONS: In Canada 1 year $48.15 (incl GST) (NB, NS, NF $51.75 includes HST); 2 years $86.67 (incl GST) (NB, NS, NF $93.15 includes HST). USA and other foreign payable in US $ 1 year $52.00, 2 years $94.00.

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Foundation Construction

Richard Kadulski

Foundations are perhaps the most important part of a building, because they are the base on which all else is built. If its foundation is inadequate, a building will not stand properly. The foundation must be structurally capable of holding the loads imposed by the building and occupants. Foundations must also be able to withstand natural forces acting on them in the ground, such as soil pressures and ground water,. For the benefit of the building's occupants, a foundation must keep out moisture and soil gases.

You would think that such a fundamental element as a foundation would not be a problem. After all, we have been building for how long now? Yet foundations are still one of the biggest problem areas in new housing.

Sometimes the problem is one of people persisting in building inappropriate designs. In areas with high water tables, in-ground basements simply should not be built. Yet in many places we still see full depth basements with elaborate measures taken to keep the water out.

Traditionally, full basements were built simply because, in many places, the frost line is deep, so the excavation had to be deep to put the foundation footings below the frost line. Rather than filling the excavation, the basement was used to provide an unconditioned space for cold storage and for the fuel used by dirty, inefficient heating devices. If ground water and soil gases migrated into the basement, as was usually the case, it did not really affect the occupants. The space was not finished, was reasonably well ventilated to the outdoors through a very (air) leaky envelope, was not used as living space, and was usually separated from the main living area.

Unfortunately, the way we build basements has not kept pace with the way we use them. While today's basement still usually contains the utility and mechanical services, it is frequently finished and used as living space (whether it is done when the house is first built, or soon after). This means we have to rethink how we build and finish the basement.

When used as living space, the basement has to be insulated, heated and ventilated. Structurally, the foundation has to be more durable and water resistant, as moisture and soil gases have to be managed. However, the dynamics of heat, air and moisture flows in basement conditions are different from above grade construction. Durable, proven construction details still elude many builders. That is why basements are a major source of call-backs and warranty claims in many locations. A major research program is underway at the National Research Council to look at many of common basement problems. In the future, we will be able to report on the findings of this research.

In this issue we present a few ideas to consider when selecting the details to use when building a basement.

Keeping Basements Dry

The major problem with basements is water. Moisture can enter a basement many ways: by floods, leaks in walls and floor, capillary migration of ground water into the house, and leaky plumbing. In addition, summertime cool basement temperatures can cause condensation of water from warm humid exterior air. Water in the basement can affect furnishings and possessions in the basement and contribute to structural deterioration by fungal action on wood. What is more important, it can lead to mould growth that can cause health problems for the occupants.

Some of the research presently underway is looking at wall systems that will dry quickly. In other words, how can we finish and insulate the interior in such a way that it will dry if it gets wet?

Perhaps, we also need to consider how to keep the water out. We offer our suggestions here.

1. Do not build a basement in a high water table area. The basement floor should always be above the normal high water mark. If you need to rely on pumps or waterproofing of the basement, you will always encounter problems at some point. After

all, pumps are mechanical and can fail; electricity is subject to outages - too often during severe storms. The simple answer is: don't do it! Explain the problems to your customer, and encourage the use of a slab-on-grade or heated crawlspace as an option. It should even be cheaper to build.

2. Manage ground water so that it avoids the foundation. Preserved wood foundation guidelines offer one means of keeping water away, by placing the entire foundation on a bed of compacted crushed rock (or rock and crushed glass). This layer acts as a capillary break for ground water. It also acts as a reservoir for sudden water accumulation, as may happen during occasional torrential downpours. This may still require storm water drainage management, by using perimeter drain tiles. You do not have to build wood foundations to take advantage of this principle. Standard concrete foundations can also be built this way.

3. Don't collect roof runoff water into the perimeter drain tile. Roof water should either be collected in a separate solid collection pipe independent of the perimeter drain tile (which can be near the surface) and taken away to a storm water system, or allowed to drain into the ground away from the house. If a sump is required, don't put it inside the basement.

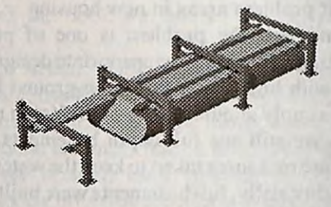
4. Keep ground water away from the foundation wall. Most people still think that the bituminous damp-proofing coat applied to the foundation is waterproofing. Nothing could be further from the truth. The coating is merely a sealer for the concrete, to seal the small capillary pores that can draw ground water into the concrete.

A much more effective solution is to apply free flowing drainage against the foundation. In the past, this meant backfilling against the foundation with an aggregate, like drain rock. This can be costly. Today, a number of manufacturers have products that act like drain rock. These products create a loose layer against the foundation so that any water that might contact the wall will drain by gravity rather than press against the concrete. In areas with severe frost conditions, these materials also act as a slip layer, reducing the ice pressures on foundation walls. Properly applied, these materials may eliminate the need for conventional damp-proofing, partially offsetting the incremental cost. Some manufacturers sell their products only through approved applicators, and will provide waterproofing guarantees.

For a short period, such drainage layers were a code requirement in Ontario. During the period this was in the code, basement leakage problems decreased substantially.

5. When installing a drainage layer against the foundation, provide a flashing at the base, to ensure that water flowing down will not pool on top of the footing, but will be deflected away to the perimeter drainage.

6. Place a capillary break under the footing. This can be a strip of poly or a plastic drain layer laid under the footing forms. This reduces ground water being wicked up into the foundation wall.



Another option is to use a footing system like the Fastfoot® system. This forming system uses a plastic fabric material that remains in place, instead of conventional wood formwork. The fabric is a sheet plastic that can offer an effective capillary break.

7. If the footing is poured separately, strip all wood spacers from the forms before pouring the wall. Any wood blocks that remain will eventually rot and create a path for ground water.

8. Ensure that the concrete wall is structurally adequate, and properly poured. Cracks and other imperfections in the wall provide potential channels for water and soil gases to get inside the basement, no matter how carefully you seal the wall.

Bracing and Reinforcing Requirements for Foundation Walls

Unreinforced (or very minimally reinforced) walls are being built every day, and they are not collapsing. On the other hand, engineers, who specify even the minimum reinforcing listed in the building code are accused of over-designing the foundation. So why are walls not collapsing all over the place? Simply put, the continuity of the monolithic concrete foundation wall system gives the system the ability to span between wall supports. Where foundations have failed, the vast majority of the failures are the result of frost action or volume change in the soil.

Concerns have been expressed by some Alberta municipalities that current construction practices for detached houses, semi-detached houses and row houses do not provide enough lateral bracing for concrete foundation walls. One reason for the concern is the lack of bracing provided foundation walls that are parallel to the floor joists. Another is the increasing practice of building nine-foot basement walls with backfill heights of more than 7'6" (2.30 metres).

In response to these concerns, the Alberta Housing Industry Technical Committee supported by CMHC commissioned a review of the structural adequacy of typical concrete foundation walls to resist lateral earth pressures. The study was limited to 8" thick concrete walls 8'-0" and 9'-0" high subject to soil types commonly found in Alberta. For comparison, the study included the code-specified minimum backfill pressures.

Several interesting things were discovered.

1. Lateral earth pressures are much higher than the building code specified minimum value.

The main problem with the prediction of lateral earth pressures against foundation walls is the variability of the soil itself and its non-homogeneous nature. Because doing soil testing on each residential site is not practical, generalizations are made. In reality, a range of values can be expected depending on soil grain size and distribution, grain composition, moisture content, geological history, and many other factors.

The minimum backfill pressure outlined in the code is based on incorrect assumptions. Hydrostatic pressures are not considered. Neither is there an allowance for frost heaving pressures against the wall that can add 200% or more pressure to it. This is because it is assumed drainage is in place. The code minimum value of 30 pcf is based on retaining wall pressures for a very free-draining coarse-grained soil and a wall that is free to rotate at the top. This is generally not the case in foundations.

2. The building codes does not require steel reinforcement of concrete foundation walls.

The nominal strength of the concrete wall is substantial, so vertical reinforcement may not be required in many situations. However, the code recommends shrinkage steel for an 8" wall as 10 M at 12" on centre verticals and 10 M on centre horizontals. For high backfills, some reinforcement is appropriate.

Typical Industry Reinforcement Practice

8" thick concrete foundation wall, using 20 Mpa concrete @ 28 days, nominally reinforced with 2 - 10 M horizontal steel rebars at top, and 2 - 10 M horizontal steel rebars at bottom of the wall.

However, a 9' -0" high wall has a bending stress that is 45% higher than an 8' 0" wall fully backfilled with the same type of material. The minimum reinforcement in an 8" thick wall should be:

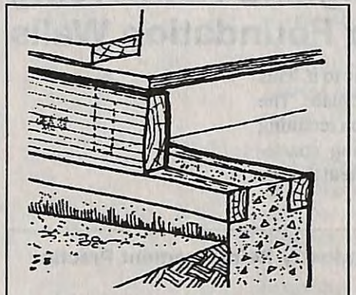
vertical: 10M @ 12" o/c or 15M @ 24" o/c
horizontal: 10M @ 10" o/c or 15M @ 20" o/c

3. Part 9 of the code refers to the concept of a laterally supported foundation wall. However, the nominal top of wall connection specified in the code cannot provide the required reaction for a vertically spanning wall. For foundation walls to be considered laterally supported, a properly designed top of wall connection is required. The Alberta industry standard practice for top of wall connections is usually not adequate to resist the calculated lateral forces. The strength of the lateral connection from the top of the foundation wall to the floor system requires attention.

standard practice for top of wall connections is usually not adequate to resist calculated lateral forces. The strength of the connection from top of the foundation wall to the floor system requires attention.

The code assumes that foundation walls are supported at the top if the floor system is anchored to the top of the foundation walls with anchor bolts. However, this does not make sense for endwalls where joists run parallel to the wall unless there is blocking, perpendicular to the wall. In typical residential construction, blocking is not provided

Lateral Bracing of Residential Concrete Foundation Walls
Bearden Engineering Consultants Ltd.
Copies of the Guidelines and report are available from the Alberta Home Builders' Association.



The Alberta practice for framing the top of the foundation wall is to use a 2 x 4 "ladder" sill with cross blocking spaced no more than 48" o/c. This differs from conventional platform framing where the sill plate is anchored with bolts to the top of the foundation wall.

for the end walls; but for proper load transfer it should be provided to transfer the load up into the rigid diaphragm above.

Using short angled walls and beam pockets to laterally stabilize the wall is neither a practical nor effective way to provide the required support.

4. Window openings in the wall and stairwell openings next to the wall require local reinforcement around these areas.

Next to windows and stairwell openings, two 15M verticals spaced at 12" on centre provide the additional reliability. Around windows, two 15M horizontals spaced at 6" on centre starting 2" below the opening and extending a minimum of 24" beyond the opening each side would be reasonable.

Depending on the type of backfill, an uncracked 8" concrete wall has enough strength to resist all backfill pressures up to 8' -6" on a 9' -0" wall. However, basing a design on uncracked concrete is not appropriate because there is usually shrinkage cracking from curing. Even if this occurs, past performance has generally shown that most foundation walls perform adequately without vertical reinforcing. Vertical reinforcing may still be necessary for 9' -0" walls especially under high backfills.

To provide a safety factor equal to 2.0, it is necessary to limit the maximum unsupported wall lengths. Cross-bridging systems that attach to the rim joist are not effective at transferring a lateral load because they rely on the outer portion of the ladder sill.

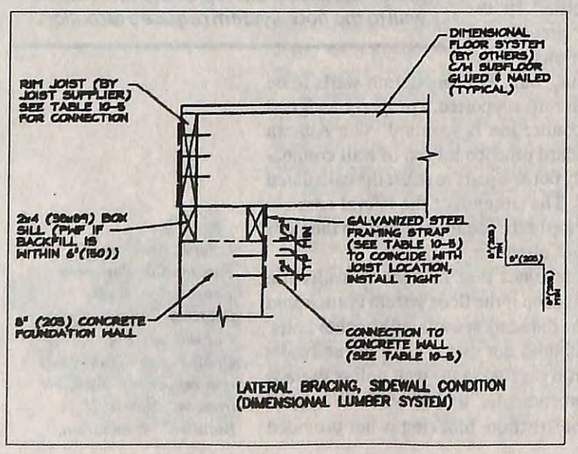
Using the findings of the study, the Alberta Housing Industry Technical Committee developed guidelines for lateral bracing of residential concrete foundation walls. These are simple guidelines, that help a builder determine if lateral bracing is required, what reinforcing is needed, if and what type of lateral bracing is needed, and what bracing is needed for window and stair openings.

Maximum allowable wall lengths without bracing are summarized in table 1.

Top of Wall Lateral Support

Historically, toe-nailing of the joists to the box sill has been the only lateral connection provided with concrete foundation walls. The minimum required nailing of floor joists to plate specified by the code is 2- 82mm (3¼") nails.

However, to provide adequate strength, 6 -3" toenails or 5 -3½" toenails would be required at each joist. This amount of nailing into a box sill connection is not physically possible. Thus, toenailing is not an effective method for providing lateral support to the top of foundation walls, except for very low backfill levels.



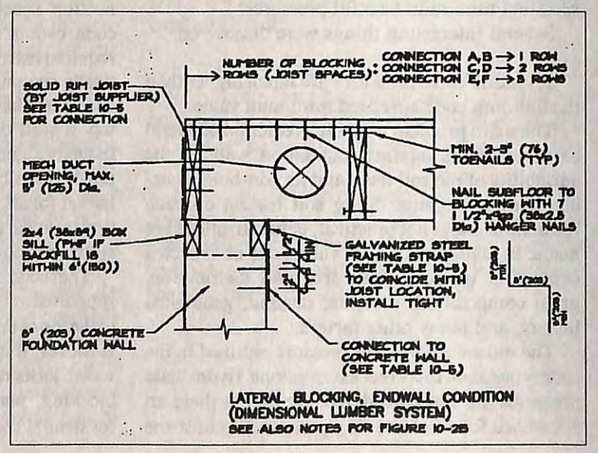
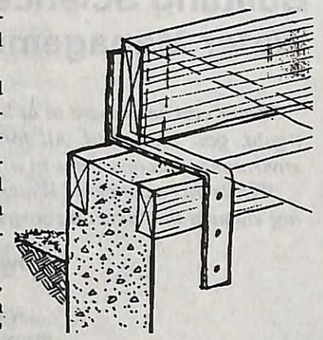


Table 1

Maximum Unsupported Wall Lengths without Lateral Bracing

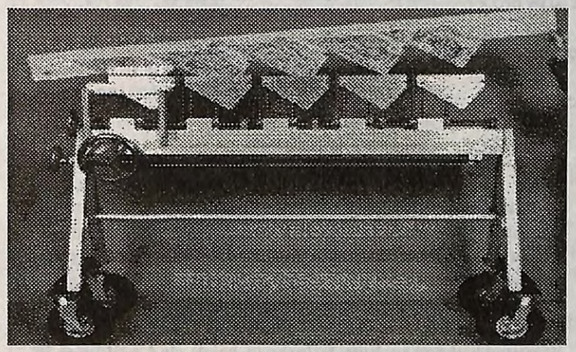
Wall Height	Backfill Height (feet)	Maximum Length (feet)
8 Feet (2.44 m)	4	60
	5	60
	6	45
	7	26
	7.5	25
9 Feet (2.74 m)	4	60
	5	60
	6	52
	7	28
	8	23
	8.5	21



The preferred detail for lateral load transfer is one similar to that commonly used for Preserved Wood Foundation construction. This uses a galvanized steel framing strap. This detail maintains current practices as much a possible, and is very effective in providing the required reaction.

These straps are easy to install, inexpensive and able to transfer high loads. Galvanized strap ties 1.25" (32mm) wide by 20ga and up are readily available in various lengths from connector suppliers such as MGA Connectors and Simpsons Strong-Tie.

Prefab Stair System



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www.bcmi.com

Building traditional stairs requires deep notches into the wood fiber of a 2x12 to make a stringer. Not only does this waste wood fiber through cutting that particular stringer, but if the carpenter makes a mistake, he is forced to throw away the stringer - an expensive piece of wood.

A new engineered stair system offers a solution to reduce waste and speed stair construction. Essentially, the system uses an engineered OSB component that attaches to 2x6 or wider dimension lumber, using a prefab jig. The system allows for easy adjustments to rise/run measurements. By using the full uncut lumber as the stringer, waste is reduced and the resulting system is stronger than traditional notched stringers.

EasyRiser®, as the system is known, was developed by EasyRiser Engineered Stair Systems of Minneapolis MN. The system is code approved in the USA for either three stringer applications or two stringer applications up to 48" wide.

Building Science 101: Water Management

Water can be present in at least two of three forms at the same time: liquid, gas, and solid. All forms appear within the normal range of environmental conditions in which buildings operate.

Why is this a concern? Water is the single most complex and devastating element that acts on construction.

How water moves

Water can move from one place to another in many ways, most commonly by gravity, through capillary action, air flow, and by diffusion.

Bulk Water Movement by Gravity

Bulk water is obvious and the easiest to deal with because it is visible. Gravity causes liquid water to seek its lowest point, travelling the path of least resistance. For example, if improper drainage directs surface runoff toward a basement wall, the runoff may enter the building through a crack in the wall and cause a basement leak. Similarly, a roof leak, wet walls, etc., can be reduced by proper design and construction that sheds water. This means the appropriate use of flashings, eaves troughs and drains to control water flows, and proper grading to direct water away from the house.

Capillary Action

Capillary action is more difficult to deal with because its source is not obvious. Capillary forces cause liquid water to move upwards, downwards or sideways through porous materials. A common example is the water a paper towel absorbs when one corner is put into a liquid.

Water will rise by capillary action up a foundation wall or slab until it is released into an area with a low water vapour pressure, usually inside the basement or crawlspace. This is often why the bottom few inches of a basement or crawlspace wall appear damp. Building a basement in sand is great for eliminating bulk water but provides no protection against the capillary rise of water.

Capillarity is a factor that must also be considered in wall design. Surface water absorbed into the cladding can move into other materials in the wall if there is no capillary break to stop the water transfer. Thus stucco applied directly to sheathing paper that is firmly in contact with plywood or OSB sheets does not provide a capillary break for any moisture that may migrate through the stucco.

Similarly, wood siding directly in contact with sheathing, without any gaps, has no capillary break, and may retain moisture.

Since water is an essential element for life, have we not learned how to deal with it yet? Unfortunately, the interaction of water and materials can be complex. And no, we don't always appreciate the effect, especially as today we build much more sophisticated buildings than in the past. Problems in the construction industry are dominated by the presence of water in some form.

If we did know how to deal with water problems, then many people would not be employed doing remedial work. The leaky buildings we have seen in so many places would be much rarer than they are.

Sometimes errors are made despite the best intentions.. Too often, mistakes are repeated, especially within a market area. In normal market conditions, a few buildings may be built with faulty details before a problem emerges, and corrective action is taken. However, when there is a construction boom in a given market area, quality assurance standards invariably slip in the rush, and many buildings may be built without adequate quality assurance. By the time the nature of the problem is ascertained, many buildings may have been built with the poor detailing.

Examples of building failures that are attributable to water leakage include failures in brick clad buildings in Ontario, EIFS system failures in South Carolina, leaky condos in BC, and siding failures in Nova Scotia. The impact on our industry is tremendous. Whenever a major and consistent problem emerges, it inevitably leads to the education of the general population, not to mention the construction industry itself. It also spawns its own industry as angry consumers support lawyers in generating class action lawsuits. It also reduces consumer confidence in the industry, and leads to new regulations.

There are two ways to reduce capillary action. One is to seal the pores in materials to prevent the entry of water. This is done by applying coatings or membranes. The second approach is to make the pores too big for water entry by capillary forces. An example of this in above ground walls is to create an air space between exterior cladding and the sheathing membrane.

A common misconception with stucco is to assume that it is waterproof. To ensure there is less moisture migration, sealer coatings are often applied to reduce water penetration. This approach is called face sealing.

Vapour Diffusion

Vapour diffusion is the process by which water vapour passes through materials. Just as heat flows from a warm area to a cool area, water vapour will seek to move from an area of high vapour pressure to an area of low vapour pressure. The rate at which water vapour diffuses through a wall depends on the difference in vapour pressure on either side of the wall and the water vapour transmission characteristics of the materials.

Vapour Permeance of Various Materials

Material	*ng/Pa-s-m²*
0.03-mm (1-mil) aluminum foil	negligible
25-mm (1-in.) foil-faced polyurethane	negligible
foil faced gypsum board	negligible
0.15-mm (6-mil) polyethylene	1.6-5.8
0.10-mm (4-mil) polyethylene	3.4-5.0
0.05-mm (2-mil) polyethylene	7.0-13.0
1 coat vapour retarder paint	2
1 coat alkyd low lustre	2
25-mm (1-in.) extruded polystyrene (Types 3 and 4)	23-92
6-mm (1/4-in.) plywood	23-74
11-mm (7/16-in.) OSB	44-200
2 coats alkyd paint on plaster	91-172
25-mm (1-in.) expanded polystyrene (Types 1 and 2)	115-333
1 coat latex sealer plus 1 coat latex paint	147-257

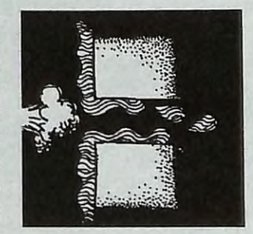
The Building Code considers any material with a vapour permeance of 60 ng/Pa-s-m² to be a vapour barrier.

Water vapour by itself is usually not a problem. However, when water vapour is cooled, it condenses and can result in problems. To reduce the damaging effects of moisture flow by vapour diffusion, vapour diffusion retarders (or more commonly vapour barriers) are used on the side that has the higher vapour pressures - usually the interior. Since some materials slow the diffusion of moisture better than others, the Building Code has established certain performance requirements for vapour retarders. To ensure that water vapour does not reach a temperature where it will condense, the vapour diffusion retarder must be placed on the warm side of the wall.

In a cold dry climate, such as on the prairies, the vapour pressure difference between interior conditioned space at 22°C and outdoor sub-zero temperatures can be very significant, which is why using good vapour diffusion retarders is very important. In a milder climate, such as Vancouver, where the outdoor temperature typically is only a few degrees cooler than inside, the vapour pressure differential is not as significant, so vapour diffusion retarders as not as critical.

We have become used to thinking of polyethylene as the vapour barrier. However, the building code also recognizes many other products that can function as vapour diffusion barriers. Low permeance paints are the most common alternatives. Other products that have similar properties include plywood, foil backed drywall, and vinyl wall coverings.

Air Flows

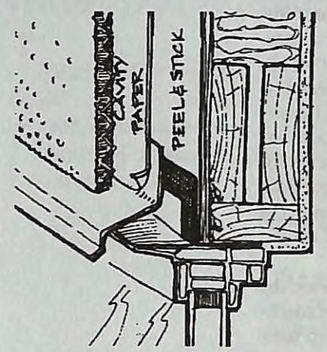


Air flow is an important moisture movement mechanism. If there are gaps and openings in the envelope, and there is a force to move it, moving air can transport large quantities of water. If there is an obvious hole, it can allow large quantities of bulk water to enter. In that case, the holes are quickly plugged. However, the bigger problem is smaller, less noticeable holes through which air flow can move warm moist air into a cooler area, where the water vapour will condense, wetting construction materials. Wet materials within a construction lead to major problems, as many of those materials are in places that are not easy to dry.

(Cont. on page 10)

Attention to Details Is Critical

A Case Study of What Can Happen to Defeat a Good Idea



In the Vancouver area, leakage problems have lead to a lot of searching for optimum materials and details to use to reduce leakage.

Peel and stick is a material with good structural properties and, properly applied, ensures excellent waterproofing. As a result, its use has increased drastically, especially in multi-family dwelling construction. Peel and stick is often used as the principal moisture barrier, and is typically applied on the exterior of the sheathing, to provide a good airtight envelope. Usually, rigid insulation is applied overtop before the finished cladding (typically stucco) as the peel and stick is also a nearly perfect vapour barrier.

Since window openings are one of the main leakage points, peel and stick is also used around the window openings. This is often the case even in those projects where more conventional building paper is used as sheathing membrane. However, the peel and stick is not always covered with insulation. This results in a condition where the peel and stick ends up on the cold side of the envelope. Result? Moisture deterioration in the framing materials of the window header.

Is this moisture the result of condensation because of water leakage, or condensation of construction moisture? It is most likely moisture within the framing lumber itself. Window headers contain more lumber than the rest of a wall. These built-up headers can contain larger absolute quantities of moisture (especially within the heart of the lumber). However, moisture readings typically consider only the surface, so even if a header is tested, it may measure an acceptable 19% or less moisture content. However, the water contained within the middle of the lumber will still be there, and will take a longer time to dry out to equilibrium conditions.

While this is a surprise and source of concern, it does point to the importance of carefully examining all details in their most minute detail. It is not only important to review the details on paper, but they must also be examined in the field as they are being built.

One detail some builders are using that seems to work is to apply the peel and stick over normal sheathing paper. In this case the paper may be acting as a wick to move water away.

(Cont. from page 9)

Measurements have shown that the absolute amount of water moved by air movement is about 100 times that by diffusion through materials. That is why good building practice and building codes require that a construction assembly be built air tight. It is less critical that the vapour barrier is complete.

The location of the air barrier in the construction assembly is not critical. What is important is that the barrier be structurally able to handle the loads to which it will be subjected.

It is possible to have a vapour permeable air barrier. Unsealed drywall and concrete are two materials that can be very air tight, yet are very vapour permeable. However, the vapour barrier must always be in a location kept above the dew point. Usually, this means it will be on the inside, but it can also be part way inside the wall. The building code has recognized that this can be climate dependent, so it provides a chart for calculating the allowable position of the vapour barrier.

Technical Research Committee News

Canadian Home Builders' Association

Ventilation Requirement Standard

Since the BC and Ontario building codes have deviated from the National Building Code model, the application and enforcement of code ventilation standards in those two provinces has not been of uppermost concern, as the regulations have been drafted in a more builder friendly fashion. However, in the rest of the country, where the NBC (1995) standards apply, ventilation is a continuing concern.

Field surveys of installation practices have shown a lack of compliance with the code. Some of the non-compliance may have been relatively minor issues. However, problems included instances of excess depressurization (thus conflicting with gas codes and potentially compromising safety) and a potential for excessive cold air to pass over furnace heat exchangers (which can lead to condensation and shorten the safe life of the furnace).

CHBA is supporting a project that will draft new revisions for NBC ventilation requirements. However, it will still take some time for the revisions to be drafted and reviewed. In the meantime, builders are reminded that the R-2000 program provides a proven strategy for effective ventilation. In addition, the existing code also refers to CSA F326 as the basic standard on which the NBC requirements are based. Builders are advised, especially where combustion gas spillage susceptible equipment is being used, to use the F326 performance route in the design of their ventilation systems.

Alternatives to Regulation

No one wants to be told what they have to do. However, as we don't live on an isolated desert island, we have to take into account our neighbours and community. This means that there are many pressures generating a variety of public policy objectives.

We've all been confronted with the NIMBYism (Not In My Back Yard) at one time or another. Heaven forbid, but we may even been NIMBYS ourselves at some time! However, each NIMBY incident often generates pressures for more regulations, always with the lofty public policy objectives. CHBA has prepared a discussion paper on the ways public policy objectives can be achieved without resorting to regulations or incentives.

Bubble Wrap Insulation Under Concrete Floors

Foil faced bubble wrap type insulation products are designed for use in assemblies that incorporate an air space on the warm side of the insulation. These materials only work as claimed and evaluated by CCMC when used in wall assemblies with the air space on the inside. Unfortunately, overzealous sales representatives push the products for applications where they will not work as claimed. One such case is using bubble wraps under concrete slabs-on-grade. Under the slab these bubble wraps do not provide the insulation value claimed.

If a salesperson makes a pitch for use under slabs, remember that you will not achieve the insulation values claimed. Bubble wrap will offer a stronger moisture barrier than regular 6 mil polyethylene, but nothing else.

Building Envelope Construction

The use of polyethylene for air and vapour barriers has been at the forefront of many discussions in recent years. Widespread use of polyethylene as an air and vapour barrier material started in the late 1960's and there has been much debate ever since. Some builders are of the opinion that the poly is the source of problems that are being encountered in some regions. At the recent TRC meeting a number of presentations were made by researchers who pointed out that research sponsored or done over the years by CMHC, Forintek, Concordia University and the Institute for Research in Construction showed that polyethylene vapour diffusion retarders did not cause problems when installed properly.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

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Nova Scotia R-2000 Builder Recognition

The R-2000 Program is undergoing a review. The technical standards are under review, to tweak the standards, and a revitalization of the program delivery and administration. An important component of the R-2000 revival in Canada must be the builder. After all, the builder is often the one the purchaser trusts and relies on for good information. If the builder is committed to R-2000 construction, this commitment will usually rub off on the purchaser.

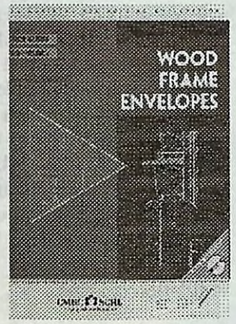
The Nova Scotia Home Builders Association continues to lead in innovative programs to foster R-2000. The recently completed R-2000 Showcase of Homes attracted 11 builders, who built 13 homes, including 3 EnviroHomes

On November 26, 1999, all the builders who took part in the 1999 Showcase were recognized with plaques. That evening, during the Sixth Annual Award Banquet and Gala, Natural Resources Canada presented a number of awards for outstanding accomplishments by Nova Scotia Home Builders Association R-2000 Builders.

Best Air Test Award
A-W. Allen & Son, Middleton NS
Environmental Awareness Award
Altimax Developments, Dartmouth, NS
Largest R-2000 Builder
Sawlor Construction, Eastern Passage, NS
Affordability Award
C & L Construction & Design Ltd., Dartmouth, NS
Long Service Award
George Foote, Halifax
Partner Recognition Award
Kerr
R-2000 Showcase Builder Recognition
Altimax Developments
Integrity Homes of Distinction
C&L Construction & Design
Cresco Homes Ltd
Fall River Village Ltd
Hanaa Homes Construction Group
Wealthy Homes Construction Limited
John D. Anderson Construction Limited
Sawlor Construction Limited
Scotian Homes Ltd.
Whitestone Developments

For information on the R-2000 Program, contact your local program office, or call
1-800-387-2000

Best Practice Guide: Wood Frame Envelopes



Wood is the traditional, time-tested residential building material in Canada. At the same time, there has been much evolution in building industry. Changes have been driven by many factors, including the availability of materials and labour, and product innovations such as sheet panels and prefabricated components. Sheathing materials have evolved from lumber boards to panel products such as plywood, fibreboard, waferboard, oriented strandboard (OSB) and other materials. Cladding materials have also evolved from hand-split shakes to asphalt roofing and prefabricated siding products. We have improved construction techniques; consumers have higher expectations about the quality and utility of housing; and there is pressure to use labour, materials and energy more efficiently. The resulting building envelope has become more weather-resistant and durable.

In the 1970s, energy-efficient and R2000 construction tightened up the building envelope by introducing improved insulation and air-barrier materials and techniques that created better thermal performance and control of air leakage. It also meant that greater attention had to be paid to interior air quality and moisture management. The resulting moisture management techniques and materials, along with improved building code enforcement and maintenance practices, have led to greater durability. In short, wood frame construction has performed well in Canada.

As an aid to builders and designers, CMHC has published the **Best Practice Guide for Wood Frame Envelopes**. This is the latest in a series of guides to the best practices for design and construction currently available. The Guide provides a conservative interpretation of state-of-the-art methods, and does not explore innovative technology that has not yet been field-tested. However, it must be noted that the details found in this publication may not be appropriate in warm, wet coastal areas such as Vancouver and the lower British Columbia mainland.

The Guide offers some interesting background information as well. Did you know that it was only in the 1920s, that the University of Saskatchewan demonstrated that insulation was useful in reducing heat loss? Sawdust, seaweed, wood shavings and shredded newsprint were the materials available at that time. The use of manufactured insulating products whose components included straw, seaweed and mineral fibres spread during the 1930s.

However, placing thermal insulation in the wall cavity reduced the temperature of the wall's outer layers, leading to the problem of moisture accumulating due to condensation. Laboratory studies examined the movement of moisture through various building materials. It was determined that materials with a high resistance to moisture vapour would prevent condensation if they were placed on the warm side of insulation. Builders also began ventilating attics to dissipate accumulated moisture. By the mid-1940s, insulation, vapour retarder sheets (usually asphalt-covered kraft paper insulation facing) and attic ventilation were in widespread use.

Air leakage causes much more moisture to migrate outward into the building envelope than does vapour diffusion. Since the 1960s, researchers have paid more attention to air exfiltration as the source of moisture within the building envelope. Initially it was thought that most exfiltration occurred around doors and windows, but in the 1970s researchers determined that about 70 per cent of the air flow was through the many unintended cracks and holes in wall and ceiling assemblies.

This Best Practice Guide provides background information as well as many details that, when suitable to a design, can be used directly or modified as required. The details and specifications are also on the CD that comes with the package, so they can be imported into CAD drawings and specifications. Each assembly detail is not just presented as a figure, but also includes an analysis of the strategy for air barriers, vapour retarders, advantages and disadvantages of a given approach, as well as a designer and builder checklist.

Best Practice Guide: Wood Frame Envelopes
by Canada Mortgage and Housing Corporation.
$89.00 available from CMHC Housing Information Centre
Tel. 1-800-668-2642
(outside Canada: 613-748-2003)
Fax 1-800-245-9274
(outside Canada: 613-748-2016)
e-mail: chic@cmhc-schl.gc.ca

Building Envelope Maintenance and Repair

Envelope components have varying life expectancies and maintenance cycles. All require regular inspection and maintenance. The table presents estimated life expectancies of materials exposed to normal weathering.

Estimated Life Expectancy of Wood Frame Construction Components

Item	*Estimated Life in Years*
Wood Frame Structure	indefinite
Exterior Sealants	4 to 10
Paint and Stain	4 to 6
Air-Barrier Sealants	15 to 25
Drywall	40 or more
Metal Siding	25
Vinyl Siding	25
Wood Siding	25 or more
Brick Veneer	50 or more
Metal Copings and Flashings	25
Windows	25 or more
Asphalt Shingles	15 or more

Window Installation Standards

Recognized standards are important to provide guidelines and minimum levels of performance. We are familiar with CSA standards that apply to electrical and plumbing fixtures and many other products and processes.

As builders and designers, we're familiar with the fact that the CSA A440 standard sets out minimum window performance criteria, although probably very few of us have ever seen a copy of it. A new section completed recently applies to window and door installation (CSA A440.4). Like many standards, it spells out in precise detail the methods for installing new and replacement windows and exterior doors.

As with all CSA standards, the document is drafted by general consensus by a committee that includes industry representation. However, in reviewing this document, I have to question which sector of the window industry developed this standard. While all issues of concern are covered, the window types covered are exclusively a traditional frame type without nailing flange. The well illustrated document does not cover nail-on flange window frames. Unless the West Coast is a notable exception, all windows I have seen here have nailing flanges. In fact, try to get a window without a nailing flange!

One also has to question the thinking behind the publication strategy. The installation standard is bundled with the rest of the A440-98 standard which also covers Window Design, User Selection Guide, Energy Performance of Windows and Other Fenestration Systems (and a user guide to energy performance calculations), so the entire package costs $215 - definitely not something that encourages installers to have their own copy.

Another serious concern is that, for replacement windows, the standard requires the full removal of the old frame. While this may be appropriate in some cases, it can also create many problems, especially with aluminum or metal frame windows. Full removal involves sawing out the old window frame at the nailing flange, inserting the rebate window in the opening and caulking it to restore the weather seal. Removing the window by separating it from its nailing flange exposes the structure behind the window frame, including the building paper (assuming the paper was properly applied initially). In the process, the weather protection at the window can be damaged, leading to water leakage.

Many home improvement contractors use a piggy-back approach, rather than remove the existing frames which, at first glance, appears to be safer than full removal. Piggy-backing involves removing any meeting rails or mullions while leaving the perimeter frame in place andstill attached to the nailing flange. The seal is made by caulking the flange of the new (vinyl) window to the face of the original metal frame, or, if the frame has no appreciable face on the exposed frame, to the exterior finish. A head flashing is seldom added, as the theory is that the nailing flange is the flashing, and if the window did not leak before, it shouldn't leak after.

Depending on the circumstance, full-removal and piggy-backing, are both successful means of replacing windows. It is too bad the committee chose to limit themselves to one approach, especially as the presence of a standard puts pressure on the industry to work according to it.

***A440 Series-98 Windows** (Contains: A440-98, Windows; A440.1-98, User Selection Guide to A440; A440.2-98, Energy Performance of Windows and Other Fenestration Systems; A440.3-98, User Guide to A440.2; and A440.4, Window and Door Installation.)*

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Letters to the Editor

Re: Advanced Framing (Solplan Review No. 88, September 1999)

When I designed and built the 1977 Leger House - arguably the first double wall super-insulated house in the USA - I used techniques developed by Frank Holtzclaw and used in the Arkansas House. The term "advanced framing" did not exist at that time. It is unfortunate that no one bothers crediting the Arkansas House as the source of "advanced framing techniques."

Your coverage is quite good. Although you mention drywall clips for use in exterior corners, the use of plastic clips is questionable. As far as I know, the only clip allowed in single family structures in California is the Prest-On metal clip.

I was disappointed with your failure to mention the unique Arkansas House technique of running electrical wiring along the bottom plate of exterior walls. This keeps it out of the way of the insulation. Also, missing from the coverage was the sealing of the outer wall sole plate, and the Arkansas raised heel truss.

Gene Lerger
Nashua, NH

Thanks for the comments. It's unfortunate that often the source of innovation isn't always remembered, especially when it's not a proprietary innovation. Our piece on advanced framing was taken largely from the publication developed by the Greater Vancouver Regional District, and no mention of the Arkansas house made.

Your comments about missing information are fair. In a short overview piece it's not always possible to cover all features. The technique of running electrical wiring along the bottom plate of exterior walls is especially noteworthy, as it really does not take too much effort (except the electrician may have to be on his knees more than normal), yet can be very effective.

As for the drywall clips, there are several manufacturers. Of course, what can be used in any given location has to be verified with local code authorities. Provided they have the required properties, there should be no reason not to use plastic clips. Although there are several clips on the market, they probably don't get a lot of usage and may have limited distribution. Ed.

Re: Carbon Monoxide (Solplan Review No. 86, May 1999)

I just read your article on Carbon Monoxide (CO) in the May 1999 issue. My congratulations! You have covered the topic well and are right on in your recommendations. It is nice to hear somebody from the building design side of the equation recommending against attached garages.

As well I was encouraged to see such an emphasis on building pressure. As you are aware you require two things for a CO problem: a CO source and some method for it to enter the home. There are many potential sources for CO but localized or full building depressurization is usually the way it enters the living area.

Once again, well done!

Ken Harding-Rooney
Trades Instructor, BC Gas

Under Counter Sink Mounts

Sinks mounted under the counter look attractive and clean, and in some cases, they are important because a clean counter top is easier to keep sanitary. But, under-counter sinks can be expensive. A Port Coquitlam, BC company offers a poor man's version of stylish under counter sinks. The company has developed a seal (marketed as Counter-SealÔ) that can be used with many conventional kitchen, bar and vanity sinks. The seal enables the undermounting of sinks in plastic laminate, solid surface, veneer and tile counter-tops. The seal is available in a wide range of Wilsonart colours and is designed to match specific styles of sinks.

For information:
Contact the distributors: In Canada: McKillican Canadian Inc.; in the USA: Babcock Lumber Company. Or directly at info@counter-seal.com (www.counter-seal.com)

Energy Answers

Rob Dumont

Midnight, December 31, 1999 is coming up soon. Do you have any recommendations on how to heat your house if the electricity fails?

I don't know quite what will happen as Y2K rolls around. I do know that, as the electrical industry deregulates, the safety margins on equipment are likely to decrease, and we are likely to have more, not fewer, brown-outs, black-outs and other problems. Reliability costs money.

Here are some suggestions that will work on New Year's Eve, or any time you lose your electricity during the heating season.

1. **Don't** use your propane barbecue to heat your house. Although many barbies can put out about 30,000 or 40,000 Btu/hour and keep the house warm for a while, the burners are usually very dirty from accumulated fat and dust. Dirty burners produce carbon monoxide, a colourless, odourless, tasteless killer. Apparently about half a dozen people died of carbon monoxide poisoning during the ice storm in Ontario and Quebec from using their barbecues.

2. **Don't** use a charcoal briquet barbecue inside either. They produce even more carbon monoxide. I have never yet seen a portable fuel-fired barbecue that could safely be used inside a house. Don't even think of using your barbecue indoors.

3. Forget about using your gas furnace. Almost all of them require electricity for the thermostat and for the forced air fan. Newer models also have an induced draft fan for the exhaust gases.

I have friends in Ottawa who had an older, gravity circulation gas boiler in their house that had a millivolt thermostat powered by the standing pilot light. Their boiler was able to work satisfactorily even when the ice storm took out the electrical power. However, such installations are very rare these days.

4. Keep a flashlight with fresh batteries, and also some spare batteries. Candles are also handy, but be warned that they can release a lot of soot that will discolour walls and carpets.

5. If it looks like the house is going to freeze, turn off the water supply to your house. Drain all the water from the lowest point in the plumbing in your house. Leave the taps open so that the pressure that develops from the expanding ice will have some place to release. If the taps are open, you are much less prone to having a pipe burst. If a pipe bursts and the water supply is under pressure, your house will be a terrible mess.

6. If you have a conventional gas water heater in your house, you can convert it into a space heating source. Jon Eakes has noted that some people did this during the ice storm in Ontario and Quebec. Here's how you do it. However, note that this technique will only work if you have both natural gas and pressurized water at your house after the electrical power goes out.

Take two lengths of garden hose and attach them in series to the tap on the bottom of your water heater. Lay the lengths of hose on the basement floor and have the outlet stuck in a floor drain. Open the tap on the bottom of the water heater and slowly trickle water out of the water heater. The hose will get quite warm near the tank. Do not put any valves or restrictions in the hoses or the warm hose may burst! The hose on the floor will serve as heat exchanger, transferring heat from the water into the air in the basement. If the door to the upstairs is left open, heat will be transferred by natural convection to the upper floors.

Conventional gas (or propane) water heaters do not require any electricity, and thus the above system is a way of getting heat into the house when the power is out. Most water heaters can produce about 30,000 Btu/hour of useful heat, which will keep many homes warm. Even a large home will benefit by this technique, and could be kept from freezing.

Water heaters are quite able to withstand continuous operation with cold water entering. An increasing number of people are using them as space heaters in combo systems. I have used a single water heater as a combined space heater/ water heater in a house for 13 years.

7. If you have a fireplace or wood heater, you can of course use them. Be warned, however, that an open hearth fireplace is a terrible space heating source. The open hearth units draw so much room air out of the house and up the chimney in cold weather that they are almost of no value as a space heating device. An airtight wood heater is a much better option. Just make sure that the wood heater and venting system are able to work safely when used a lot. Chimney fires are a frightening experience!

Apparently most Canadian electric utilities have invested a lot in preparing for Y2K. They have set their system clocks forward so that the clocks are now set beyond the December 31, 1999 changeover date. However, with so many different electric utilities interconnected in North America, I will be very surprised if at least part of the electrical network does not go down on New Year's Eve.

We in North America will have at least a few hours warning of system breakdowns, as the date changeover starts near New Zealand, and we will be among the last people to experience the new millenium. May December 31, 1999 be a warm day throughout the world!

Those people with the foresight or good luck to live in an energy efficient house will be getting an important dividend from their investment, if not at Y2K, then likely at some time in the not-too-distant future.

Technical Excellence Award

The powers that be at the Greater Vancouver Home Builders' Association deemed your humble editor worthy to be the recipient of the 1999 GVHBA Technical Excellence Award.

All I can say is, thank you for your recognition. Richard Kadulski

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Combo Heating Systems Testing at CCHT

NRC·CNRC

By Will Koroluk

Driven by a commitment to reduce levels of carbon dioxide emissions as a part of the Kyoto Protocol, Canadian manufacturers and researchers are seeking ways to do just that.

It's no surprise, therefore, that early projects being undertaken at the new Canadian Centre for Housing Technology (CCHT), involve innovative "combo" systems for home heating. These systems roll space heating and water heating together into a single system. They provide domestic hot water, but also contain a fan coil so that heat extracted from the water can be used to heat the house. Thus one burner is used for both water heating and space heating.

Luc Saint-Martin, CCHT's business manager, says the test systems are being installed now, and should be ready in time for experimentation to begin in the new year. The experiment, which involves two different water heaters from two different manufacturers, will take 12 weeks to run. The experiment will schedule the water draws in the house according to the ASTM standard for water heaters, which provides for specific amounts of hot water to be drawn at specific times of day—large amounts needed for morning showers, for example, or for running a dishwasher in the evening.

"Doing that will provide for a realistic simulation, so we'll be able to see what effect those draws on the hot-water supply have on heating the house," he says.

The project dovetails nicely with the interests of the Advanced Integrated Mechanical Systems (AIMS) project being run by Natural Resources Canada (NRCan), which is one of the partners in CCHT. NRCan is providing some of the funding for the combo project at CCHT, along with Union Gas and Enbridge Consumers Gas.

Along with NRCan, the partners in CCHT are the National Research Council (NRC) and Canada Mortgage and Housing Corporation (CMHC). NRC, through the Institute for Research in Construction is the centre's operating agent and Saint-Martin's employer.

Built at a cost of $1.6 million, CCHT is made up of two identical detached homes and a three-unit townhouse, all built to R-2000 standards. The townhouses provide display space, and office and meeting facilities.

The twin houses simulate occupancy of a typical Canadian family, and, through sophisticated monitoring, can measure even the most subtle changes in the indoor environment. They are identical in every respect because one must serve as a "reference house" to serve as an experimental control. The house beside it is where the experiments are done. Thus, a combo system can be installed in the test house and its performance and impact measured against the reference house.

Saint-Martin says there are already more projects lined up to follow the work on combo systems. "One involves a radiant paint developed by a large company with international operations," he says. "The manufacturer wants to assess how well the paint performs its function of reflecting heat back into the house, enabling occupants to be comfortable at lower thermostat settings."

"Another is a system of light-actuated window blinds that close automatically and reduce heat gain from the sun. This, of course, would result in energy savings as air conditioners would not have to work as hard."

As part of the Kyoto agreement, Canada—along with many other nations—agreed to stringent reductions its emissions of greenhouse gases, which explains the interest of manufacturers and researchers.

Industry reaction to the CCHT start-up has been gratifying, Saint-Martin says.

"There are a lot of new materials and new ideas out there, and we're being approached by people who want to test them. We have to find ways to accommodate them because they want to come in now."

That interest, though, serves to demonstrate the need for enlarged research facilities.

"We're limited because we can't run projects that would interfere with each other. While we're running the experiment on combo systems, for example, we can't be running another one that might affect the energy balance of the house.

"The answer, somewhere down the road, might be more research houses—either beside the present houses on the NRC's Ottawa campus, or somewhere else in the country. Perhaps, too, they could be differently built."

"There is interest by the steel and concrete industries," he said, "so it might be possible to have a house built with insulated concrete forms, for example, and of the same size, with the same features and the same orientation as the wood-frame houses. That would enable them to run head-to-head with the wood-frame houses so the performance could be compared."

The big stumbling block, of course, is money.

"We know someone who is prepared to come in and build a radiant floor and someone else who is prepared to do insulated concrete walls. But that's not a house; that's maybe 25 per cent of a house. Where do we get the other 75 per cent?"

Saint-Martin emphasized that any suggestion of expansion is just speculation, because the subject hasn't even been talked about with the CCHT partners.

"For now, we've got plenty to do, including lining up more research projects."

Luc Saint-Martin is the business manager of the Canadian Centre for Housing Technology. He can be reached by phone at (613) 991-0960 or by email at luc.saint-martin@nrc.ca

Will Koroluk is an Ottawa-based freelance writer specializing in building science.

Coming Events

Jan 16, 2000
Creating a Niche Market with Energy Value Homes with 2000 Builders Show, NAHB
Dallas, TX
Tel: 301-249-4400 Fax: 301-249-3265

Jan 19-20, 2000
Ontario Building & Renovation Forum
Toronto, ON
Tel: 416-447-0077 Fax: 416-443-9982

Jan. 23-23, 2000
Interior Design Show
Toronto, ON
Tel: 416-599-3222 Fax: 416-599-3224
www.interiordesignshow.com

Feb 13-16, 2000
CHBA's 57th National Conference
Ottawa, ON
Tel: 905-954-0730 Fax: 905-954-0732

March 9-12, 2000
World Sustainable Energy Day & Trade Show
Wels, Austria
Tel: (43)-732-6584-4380
Fax: (43)-732-6584-4383
www.esv.or.at

April 3-8, 2000
Affordable Comfort Conference
Columbus, Ohio
Tel: 800-344-4866 Fax. 724-223-7754

Apr 7-8, 2000
CIPHEX West 2000
(Plumbing & Heating Show)
Calgary, AB
Tel: 416-695-0447 Fax: 416-695-0450
www.ciph.com/ciphex/

May 11-13, 2000
Interbuild 2000
Housing and Construction Show
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e-mail: info@interbuild2000.com

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